System Sizing Using NSol! 4 -- An Overview

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NSol!

- NSol! is a sizing tool, NOT a simulation program
- Designed for sales/system engineers to rapidly evaluate a wide range of options for specific systems
- Inputs inlcude load, insolation PV module, battery and generator information
- Includes NSol!-DB insolation database and use-customizable databases for PV modules and batteries.
- Current version is 4.0

NSol! as a System Sizing Tool

- Standalone PV Systems - Energy Balance / ALR method
- Standalone PV - LOLP method
- PV-Generator Hybrid systems
- PV-Grid systems

Basic PV System Sizing Requirements

- Energy Balance -- Energy In (from PV and/or generator) vs Energy Out (used by load)
- PV Supply is variable on a daily basis (diurnal) so some storage is required
- PV Supply is also variable from day to day so additional storage is required
- PV Supply is also variable seasonally
- Electrical systems must store energy electrically -- most common is electro-chemical storage (battery)

Stand-alone PV System Sizing

- Energy Balance method -- assumes constant insolation in given month
  - BOE method is a useful tool, NSol! ALR method is simply an extension of this.
- Loss of Load Probability method -- calculates probability of supplying the load, based on variability of insolation

LOLP Fundamentals

- Assuming that insolation is variable on a daily, monthly and seasonal basis, apply standard statistical techniques (Markov Transition Matrices) to the analysis of system behavior
- Original work done by Bucciarelli (MIT Professor of Engineering), DOE/NASA (via Monegon) and Lestienne
- Bucciarelli Goal -- to allow a "tradeoff between array size and storage capacity to meet a prescribed system reliability."
- Major inputs include insolation variability and correlation.

Interpreting LOLP Results

- LOLP
  - Percentage of days that a system will “go down”
  - Related to statistical “availability”
  - Estimate of magnitude of “event”
- Battery SOC Matrix
  - Detailed look at battery analysis
  - “Minimum SOC” can be used in “elimination specs”

Hybrid Sizing

- “Active” generator makes probability arguments moot
- Fossil Fuel generator MUST make up all energy not supplied by renewable energy source.
- Generator can be turned on and off as needed, but control is based on battery.
- Typical goals are to reduce generator run time, generator fuel consumption, and/or generator contribution
- “Daily operation systems” can be estimated by adjusting battery parameters to yield 365 (or so) “starts” per year.

Village Power Applications

- Solar Home System -- Use NSol! to verify that a specific system will supply the implied load
- Central Solar PV system -- Nsol! can show effects of load variance, etc
- Central hybrid system. Lood at effect of different loads on generator run-time, etc

Interactive Sizing Example

- Size a central village power system for a 24 kWh per day load, with estimated 75% night load.
- Size a basic hybrid system to meet the same load.
- Loof at effect of battery and generator size on system operation

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